Fingerprint Capture Challenges and Opportunities

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Presentation Overview

- Importance of Fingerprint Quality
  - Impacts on identification system
- Fingerprint Capture Challenges
  - Factors that will affect/impact fingerprint capture process
- Fingerprint Capture Opportunities
  - Possible approaches/solutions to enhance fingerprint capture quality

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Importance of Fingerprint Quality in an AFIS System

- **Fingerprint Quality Impact on AFIS**
  - NIST studies have shown that image quality has a direct impact on identification match accuracy
- **Poor Fingerprint Image Quality Can Have the Following Negative Impacts in an AFIS System such as US-VISIT**
  - Potential missed identification/verification of a subject
  - Additional secondary workload process
  - Additional fingerprint examiner workload

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Factors of Poor Fingerprint Quality

Physiological	▪ Dry fingers due to natural aging process ▪ Worn ridge structure due to occupation ▪ Finer ridge structure specific to a demographic group
Behavioral	▪ Uncooperative subject ▪ Nervous Subject
Environmental	▪ Humidity / Temperature ▪ Seasonal Change ▪ Ambient Light
Operational	▪ High Throughput/ Reduced Capture Time ▪ Unclean Scanner Platen
Technological	▪ Application Graphical User Interface (GUI) ▪ Ease of Scanner Use / Interaction

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Poor Quality Image Illustrations

Dry Finger
Light Print

Moist Finger
Dark Print

Poor Finger
Placement

Worn Ridge
Structure

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Image Quality – User Demographics

- **Male – Female**
  - Female subjects have worse image quality
- **Right Hand – Left Hand**
  - Left hand fingerprint quality is worse than right hand
- **By Age of Subject**
  - Image Quality worsens as subject age increases

41,000 Subjects
24,000 Males
17,000 Females

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Image Quality Assurance Monitoring/Reporting

1	Application	Identifies if there is an application-specific image quality issue - scanner, fingerprint capture GUI etc.
2	Site/Terminal	Identifies if there is a site/terminal/operator-specific image quality issue within the application.
3	Capture device	Identifies if there is a specific scanner-related image quality issue.
4	First time or repeat visit	Identifies if there is a user-scanner learning curve impacting image quality
5	Finger	Identifies if there is a finger-specific image quality from installation ergonomics.

Identify fingerprint capture deficiencies and work with Client stakeholders to correct them.

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Image Quality Assurance
Best Fingerprint Capture Practices

Process Step #	Process Description	Recommended Procedures
1	Capturing raw fingerprint image from the scanner	▪ Proper use of vendor's fingerprint capture functions. ▪ Proper use of vendor's "scanner initialize" function if it supports scanner background mask function (without finger presence) for enhanced finger image capture.
2	Centering and cropping raw image for real-time feature extraction/quality check	▪ Use fingerprint core centering/cropping function (not geometric centering/cropping) to ensure the capture of optimum finger image area.
3	Using Image Quality Assessment software	▪ Use certified Fingerprint Image Quality Assessment software to ensure image quality.
4	Using Graphical User Interface (GUI) for fingerprint capture	▪ Use of sufficiently large image capture window during live capture to assist operator. ▪ Real-time image quality feedback to improve capture. ▪ Persistent display of poor quality capture status to operator.
5	Using Fingerprint Capture Mode	▪ Use Manual or Auto Capture Mode that best fits the application environment.
6	Compressing image for transfer to the HOST Server	▪ Use FBI Certified WSQ Image Compression software using the recommended compression settings.

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Image Quality Assurance
Use of New Tools / Standards

- **Development of Automated Image Quality Analysis Tool for Poor Quality Images**
  - Fully automated analysis tool to analyze captured poor quality images by gray scale contents, image contrast, useful image area, etc. to identify fingerprint capture related deficiencies
  - Feedback given by problem categories/percentages for remedial action
- **Use of Biometric Standards (BioAPI) for Fingerprint Capture**
  - Provides flexibility and modularity
  - Enables faster scanner technology interchange capability
  - Enables fingerprint scanner technology refresh
    - New technology scanner (ultrasound, touchless, etc.) to improve quality

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Image Quality Assurance Problems/Solutions

#	Capture Problem Description	Potential Solution
1	Incorrect Finger Placement	▪ Operator Training ▪ Fingerprint Capture GUI Enhancement
2	Dry Finger - Light Prints	▪ Finger preparation before capture ▪ Scanner Silicon Membrane/Coating (?) ▪ Enhance Scanner Driver software with improved finger conformance characteristics
3	Dark images from wet or perspiring fingers	▪ Finger preparation ▪ Scanner with Moisture Eliminator Optics
4	Degraded or worn ridge structure	▪ Finger Preparation (?) ▪ New Technology Scanners (ultrasound, touchless)

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Image Quality Assurance Summary

- Real-time image quality monitoring and reporting
- Real-time identification/resolution of capture-related problems when possible
- Use of best fingerprint capture practices
- Use of automated analysis of captured poor quality image analysis for feedback and problem resolution
- Use of biometric standards for enabling technology interchange/refresh to improve quality

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